THE "PSYCHO-MOTOR" CENTRES.—A CLINICAL CONTRIBUTION.

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NOTWITHSTANDING the great progress which has been made in the physiology of the brain in recent years, our knowledge of the functions of the cerebral cortex is still very incomplete.

I wish to refer merely to that part usually termed the motor or psycho-motor centres, the anterior and posterior central convolutions. That these convolutions have a direct relation to voluntary movements is now very generally believed. Experiments on animals, and the observation of the effects of disease in men, leave little room for doubt in this matter. But just what this relationship may be is a different question, and one upon which different views are entertained.

These views, tersely expressed, are that the cortex of the central convolutions possesses strictly motor functions—that is, its cells send out excitations which directly produce the contraction of muscles and result in voluntary acts; that the cortex of the central convolutions possesses certain sensory functions, especially that usually termed muscular sense, which are necessary for the guidance of voluntary acts, and without which the latter cannot be properly performed; that the cortex of the central convolutions possesses both sensory and motor functions, the two residing in different layers of cells in the same part of the cortex.

The first experiments on animals, as well as the first pathological observations, pointed only to motor functions, for electrical excitation of the cortex produced movement of different members, and the first observations in man were those of so-called cortical epilepsy. But a careful analysis of even the first extirpation experiments led apparently to a different conclusion. Fritsch and Hitzig, in their earliest publication, stated that the final result of destruction of a motor centre was not actual paralysis, but rather ataxia of movement, the motor disturbance being attributed to deficient knowledge of the condition of the member.

Munk has made the most careful analysis of the phenomena attending removal of the motor centres. He found loss of (*a*) the sense of pressure or contact, (*b*) of the knowledge of the position of the limb, (*c*) of the power of voluntary movement, (*d*) and of the sense of touch. The degree and permanency of the loss of function were according to the extent of brain surface which had been removed; the sense of touch being most readily, the sense of pressure least readily affected.

But loss of sensory functions after destruction of the central convolutions has not been found by all experimenters. Ferrier, especially, attributes to those convolutions only motor functions.

Observations of the effects of disease in man have also, as yet, led to no positive results. In a few instances anæsthesia, as well as monoplegia, has been found with a circumscribed lesion of the central convolutions, but in the majority of published reports only paralysis is spoken of. Wernicke believes this to be often due to imperfect observations. The detection of slight sensory disturbances requires a very careful examination, such as is not generally instituted.

The final solution of this question, if solved at all, must be obtained from the study of the results of disease in man.[1] For this purpose new and careful observations are necessary. It is with the hope of contributing something of value in this direction that the following case is here recorded.

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[1] One kind of observation which may throw much light upon this question is not mentioned in the text of the paper—that is, the study of secondary degenerations. If degeneration of pyramidal tracts follow a lesion limited to the cortex of the central convolutions, the latter must possess motor functions. Yet it might have also sensory functions, in another, say a more superficial layer of cells. This question of secondary degeneration is still *sub judice*.

A. N., age twenty-three, shoemaker, was wounded during the court-house riot, March 29, 1884. "The wound was on the right side of the head and laid bare the bone, on the surface of which a linear fractûre, without any depression, was seen. It was made by a ball which had ploughed through the scalp and just grazed the bone. The wound was four inches long, and about two and a half inches from the median line, and would have been equally divided by a line passing from one auditory meatus over the vertex to the other."

The man was unconscious for some hours after the injury, and there was occasional delirium for a period of two weeks. When consciousness returned it was observed that the left arm was entirely powerless, and that the face was drawn to the right side. No observation of the condition of the lower extremities was made. Shortly after the injury there was loss of sensibility in the hand ; a pinch was not felt. From the second or third day, for about a week, there were frequent convulsive movements of short duration, apparently limited to the muscles of the face and unattended by loss of consciousness.

Within a week power of movement at shoulder and elbow had returned, though the hand and wrist were yet powerless. After a few weeks a paresis of the left hand alone remained.

I first saw the patient seven months after the date of the injury. The foregoing statements were obtained partly from the family, partly from Dr. N. P. Dandridge, who saw the patient about a week after the wound had been received. I saw the patient three times the latter part of October, and December the 1st, 1884, and May 16, 1885. As my first examination was a hasty one and no notes were taken, I will give a description from notes of my examination on December 1st.

He is a man of average size, well built, and of good muscular development. On the right side of the head there is a linear cicatrix two and a half inches in length. The direction of the cicatrix is parallel with the sagittal suture, from which it is distant about two and three quarter inches. The central part of the cicatrix, in an antero-posterior direction, is just above the meatus auditorius. Patient does not suffer with headache, or other subjective symptoms, and, in his own opinion and that of his family, his mental powers are unimpaired. There is no impairment of sensation or motion anywhere except in the left upper extremity. He can walk long distances without difficulty, and the face, both in repose and action, shows no motor defect.

Left upper extremity.—Power in the movements at the shoulder and extension of the elbow about equals that of the right side. Can not flex the elbow quite as forcibly as the right, but, perhaps, the difference is not greater than could be accounted for by its being the left arm, and its having been used less than the other for some time. Grasp in left hand fair, but quite appreciably less than in the right. But the difference in the power of the flexors of the fingers is more apparent when he attempts to flex one or several fingers separately. Then there is a decided difference in the two hands, the greatest difference being observed in the middle and ring fingers. This difference is also manifested when he holds an object, as a pencil, between his finger-tips. He holds it well with the left hand, but with decidedly less force than with the right.

Cutaneous sensibility is good everywhere, excepting over the fingers. Elsewhere he feels the lightest touch (though in the left palm it is less accurately localized than in the right), but in the last two phalanges, both in their dorsal and palmar surfaces, he only becomes aware that the parts are touched when decided pressure is made. A small piece of coin, whose exact character is immediately recognized by the right hand, is often not felt at all when placed between the fingers of the left hand.

The knowledge of the position of the fingers is impaired. This is most marked in the middle and ring fingers. Occasionally he does not seem to know (eyes being closed) that the finger is moved. At other times he mistakes which finger it is. On the right side his knowledge in this respect is perfect.

Actions requiring some delicacy of movement are performed very awkwardly. He buttons his coat with the left hand with the greatest difficulty.

The only deep reflex action which could be elicited was slight movement in tapping the lower end of the radius. The same reflex could not be elicited in the other side.

A word more as to the improvement of the patient. According to the statement of the family, there was continuous improvement for six months, after which his condition appeared to remain stationary. I first saw him seven months after he sustained his injury. As before stated, my examination at that time was hurried, and no notes were taken ; but my impression is that both the impairment of sensation and muscular weakness were greater than they were at the time of my second examination, some five weeks later. But his condition May 16th (nearly fourteen months after the injury) was in no wise different from what it was December 1, 1884, unless it be that delicate movements, as buttoning his coat, were performed with more ease.

In this case we have no post-mortem examination to reveal the exact location and extent of the lesion. Neither does the external wound inform us just where the brain substance was injured, and especially gives us no information as to the direct cause of that injury, whether depressed fracture of the inner table of the skull, circumscribed hemorrhage, or some other condition. Nevertheless, in my opinion, we have in this instance the direct effects of a distinctly circumscribed lesion of the brain surface. The wound was over the part of the central convolutions considered to be the motor centre for the upper extremity. It is true that we might easily believe that something more than the motor centre for the arm had been affected; that, supposing the sensory centre of the arm to be in close proximity to the motor centres, both might have been injured at the same time.

But this explanation will scarcely satisfy the conditions here presented. At first there appeared[1] to have been complete loss of sensation and motion in the upper extremity, improvement occurred in both simultaneously and, apparently, equally, and now defects in both directions appear to exactly cover one another. This, it appears to me, can only be explained by the affection of a part wherein reside both motor and sensory functions.[2]

The extent of cortex involved in the lesion can not be very great, as it is quite probable that his mental powers are unimpaired. It is also probable that the injury is almost, if not altogether, limited to the cortex, for there is no evidence of secondary degeneration.

The motor symptoms are like those common to cortical paralyses when only the centre for the upper extremity is affected. The movements of the fingers are affected rather than those of the elbow and the shoulder; and the dexterity, much more than the power of movements, is impaired.

The disturbances in our patient very closely resemble those obtained by Munk experimentally. The sense of contact or pressure is the least, tactile sensation the most, impaired; while the knowledge of the position of the parts, and voluntary control over them, are affected to an intermediate extent.

Immediately after sustaining the injury the patient was unconscious. When consciousness returned paralysis of the face and arm were observed. Doubtless at this time the leg was paralyzed also, although, as patient was confined to his bed, no observation of its condition was made.

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[1] I express myself in this guarded manner because my information of his condition at that time is obtained altogether from his mother. But her statements are very clear, and I do not doubt their accuracy.

[2] If this be true, it is quite possible that the different functions reside in different layers of cells of the cortex.

Both the unconsciousness and hemiplegia, in great part, were indirect symptoms, whose occurrence is so well explained by Wernicke, and for that reason passed away in a short time. The spasmodic movements in the face, which occurred at an early period, must have been due to some irritation of its cortical centre.

It is far more difficult to explain the improvement which took place at a later period, for the paralysis which was still present after some months had elapsed must have been a direct symptom. A part of the improvement may have been due to the absorption of effused fluid liberating parts which had been deprived of their functions by mere pressure; but the greater part of the late improvement was probably due to the vicarious functioning of other parts. Munk believes that the cortex in the immediate neighborhood of the destroyed parts assumes the functions of the latter.

Perhaps sensory fibres become united with the cells of other parts of the cortex before they terminate in the central convolutions, in which they receive their final elaboration, and, for that reason, loss of sensation after destruction of the central convolutions may be in part supplied. As to their motor functions, perhaps the central convolutions act chiefly in arousing subcortical motor centres, and, in their absence, some other communication with the subcortical centres is established. Such a theory would, at least, enable us to understand how the loss of the highest centre, possessing both motor and sensory functions, might be in part supplied.